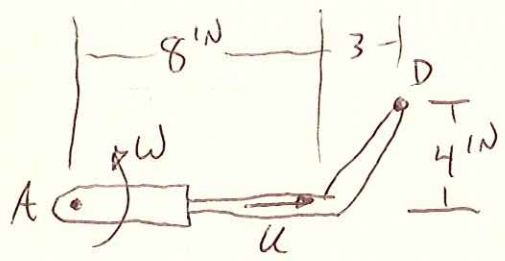
PROB. 15-166

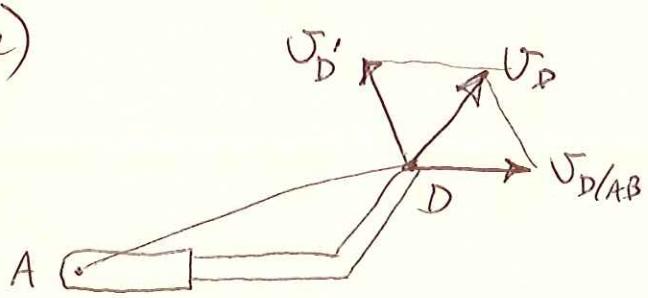


$\omega_{AB} = 2.4 \frac{RAD}{S}$ ↻

$v_{D/AB} = 10 \frac{IN}{S}$

FIND a_D FOR BOTH CASES

a)



$\vec{v}_D = \vec{v}_{D'} + \vec{v}_{D/AB}$

$\vec{v}_{D'} = \cancel{\vec{v}_A}^{\,0} + \omega_{AB}\hat{k} \times \vec{r}_{D'/A}$

$\vec{r}_{D'/A} = (11)\hat{i} + (4)\hat{j}$ IN

$$\vec{v}_{D'} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & 2.4 \\ 11 & 4 & 0 \end{vmatrix}$$

$= [0 - (2.4)(4)]\hat{i} - [0 - (2.4)(11)]\hat{j}$

$\vec{v}_{D'} = (-9.6)\hat{i} + (26.4)\hat{j} \frac{IN}{S}$

$\vec{v}_{D/AB} = (10)\hat{i} \frac{IN}{S}$

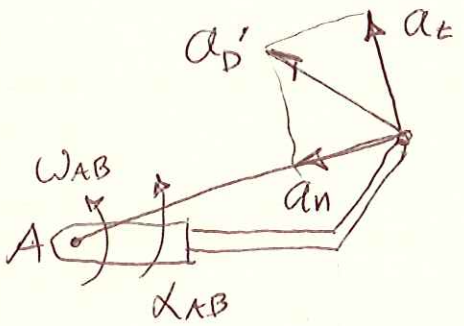
$\vec{v}_D = (-9.6)\hat{i} + (26.4)\hat{j} + (10)\hat{i}$

$\vec{v}_D = (0.4)\hat{i} + (26.4)\hat{j}$, $\theta = TAN^{-1}\left(\frac{26.4}{0.4}\right) = 89.13°$

$\vec{v}_D = 26.40 \frac{IN}{S} \angle 89.13°$

$\vec{a}_D = \vec{a}_{D'} + \vec{a}_{D/AB} + \vec{a}_C$

PROB. 15-166 CONT.



$$\vec{a}_{D'} = \vec{a}_A + \alpha_{AB}\hat{k} \times \vec{r}_{D'/A} - \omega_{AB}^2 \vec{r}_{D'/A}$$

$$\vec{a}_{D'} = -(2.4)^2\left[(11)\hat{i} + (4)\hat{j}\right]$$

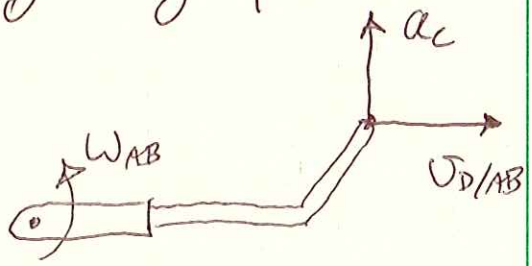
$$\vec{a}_{D'} = (-63.36)\hat{i} + (-23.04)\hat{j} \ \frac{in}{s^2}$$

$$\vec{a}_{D/AB} = 0$$

$$\vec{a}_c = 2\omega_{AB}\hat{k} \times \vec{v}_{D/AB} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & 2(2.4) \\ 10 & 0 & 0 \end{vmatrix}$$

$$= -\left[0 - 2(2.4)(10)\right]\hat{j}$$

$$\vec{a}_c = (48)\hat{j} \ \frac{in}{s^2}$$

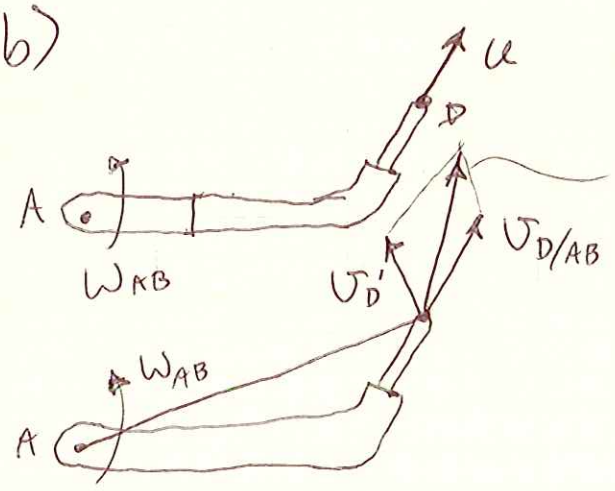


$$\vec{a}_D = (-63.36)\hat{i} + (-23.04)\hat{j} + (48)\hat{j}$$

$$\vec{a}_D = (-63.36)\hat{i} + (24.96)\hat{j}, \quad \theta = \tan^{-1}\left(\frac{24.96}{63.36}\right) = 21.5^\circ$$

$$\boxed{\vec{a}_D = 68.1 \ \frac{in}{s^2} \ \measuredangle 21.5^\circ}$$

b)



$$\vec{v}_D = \vec{v}_{D'} + \vec{v}_{D/AB}$$

$$\vec{v}_{D'} = \vec{v}_A + \omega_{AB}\hat{k} \times \vec{r}_{D'/A}$$

$$\vec{v}_{D'} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & 2.4 \\ 11 & 4 & 0 \end{vmatrix}$$

PROB. 15-166 CONT.

$$\vec{v}_{D'} = (-9.6)\hat{i} + (26.4)\hat{j} \ \frac{in}{s}$$

$$\theta = TAN^{-1}\left(\frac{4}{3}\right) = 53.13^\circ$$

$$\vec{v}_{D/AB} = (10 \cdot COS 53.13^\circ)\hat{i} + (10 \cdot SIN 53.13^\circ)\hat{j}$$

$$\vec{v}_{D/AB} = (6)\hat{i} + (8)\hat{j} \ \frac{in}{s}$$

$$\vec{v}_D = (-9.6)\hat{i} + (26.4)\hat{j} + (6)\hat{i} + (8)\hat{j}$$

$$\vec{v}_D = (-3.6)\hat{i} + (34.4)\hat{j} \ \frac{in}{s}$$

$$\vec{a}_D = \vec{a}_{D'} + \vec{a}_{D/AB} + \vec{a}_C$$

$$\vec{a}_{D'} = \cancel{\vec{a}_A}^{\,0} + \cancel{\alpha_{AB}}^{\,0}\hat{k} \times \vec{r}_{D'/A} - \omega_{AB}^2 \vec{r}_{D'/A}$$

$$\vec{a}_{D'} = (-63.36)\hat{i} + (-23.04)\hat{j} \ \frac{in}{s^2}$$

$$\vec{a}_{D/AB} = 0$$

$$\vec{a}_C = 2\omega_{AB}\hat{k} \times \vec{v}_{D/AB} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & 2(2.4) \\ 6 & 8 & 0 \end{vmatrix}$$

$$\vec{a}_C = [0 - 2(2.4)(8)]\hat{i} - [0 - 2(2.4)(6)]\hat{j}$$

$$\vec{a}_C = (-38.4)\hat{i} + (28.8)\hat{j} \ \frac{in}{s^2}$$

$$\vec{a}_D = (-63.36)\hat{i} + (-23.04)\hat{j} + (-38.4)\hat{i} + (28.8)\hat{j}$$

$$\vec{a}_D = (-101.8)\hat{i} + (5.76)\hat{j} \ \boxed{= 102.0 \ \frac{in}{s^2} \ \text{R} \ 3.238^\circ}$$